7.1 – Overview (continued)

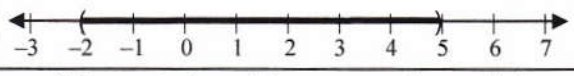
Concept	Details	Examples
Critical	Definition: Of decisive importance; crucial. "It is critical that the total weight of all passengers on the elevator does not exceed 3500 pounds."	
Critical value in statistics **(BTDT)** (Sec. 6.2)	In statistics, a **critical value** is a ***z* score** that separates unlikely values from those that are likely. Critical values will help us decide if the probability of an outcome is extremely small (Rare Event Rule, Sec. 4.1). The expression z_α denotes the z score with an area of α to its . (α is the Greek letter "alpha.") Hints for finding a critical value: 1. . 2. Use your calculator's `invNorm` function as described in the Sec. 6.2 calculator handout.	Find $z_{0.02}$. **`invNorm` (0.98,0,1) = 2.054** ***or*** **`invNorm` (0.98,0,1,LEFT) = 2.054** ***or*** **`invNorm` (0.02,0,1,RIGHT) = 2.054**

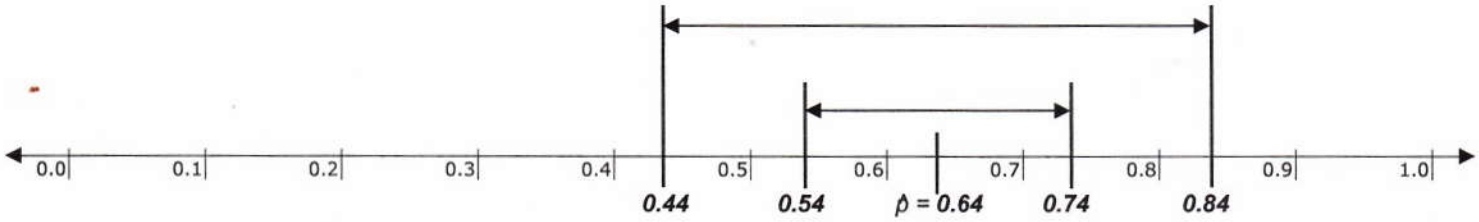
7.2 - Estimating a Population Proportion (Part 1)

Concept	Details	Examples
Binomial probability distribution **(BTDT)** (Sec. 5.3)	A **binomial probability distribution** allows us to deal with 2 outcomes (success or failure). It results from a procedure that meets these requirements: 1. The procedure has a fixed number of trials, n. 2. The trials must be independent. 3. Each trial must have all outcomes classified into two categories (successes and failures). 4. The probability of a success in one trial, p, is the same for all trials. The probability of a failure in one trial is $q = \mathbf{1 - p}$.	Say whether each of these will give us a binomial probability distribution. (a) Conduct a poll asking 50 randomly selected respondents how many pets they have. (b) Roll a die 20 times to see how many times a "4" comes up. $p =$ $q =$
Sample proportion **(BTDT)** (Sec. 6.4)	A **sample proportion** is the proportion of a *sample* with the characteristic under discussion. Examples: • the proportion of respondents who do have pets. • the proportion of times a "4" comes up. Calculate the sample proportion by dividing the number of successes by the total number in the *sample*.	Of the 43 students sampled in our Math 15 class survey, 7 are taller than 70 inches. Find the sample proportion.
Population proportion	A **population proportion** is the proportion of the *population* with the characteristic under discussion. Calculate the population proportion by dividing the number of successes by the total no. in the *population*.	Of the population of 32,563 SRJC students, 6,219 are taller than 70 inches. Find the population proportion.
Notation for proportions	p is the **population** proportion. $\hat{p}$ ("p hat") is the **sample** proportion of x successes in a sample of size n. $\hat{p} =$. $\hat{q}$ ("q hat") is the sample proportion of x failures in a sample of size n. $\hat{q} =$. The maximum possible value for $\hat{p}$ is . The minimum possible value for $\hat{p}$ is .	Find $\hat{p}$ and $\hat{q}$ for the previous example for our Math 15 class. $\hat{p} =$ $\hat{q} =$ Estimate p, the population proportion of SRJC students taking more than 8 units.
Requirements for estimating a population proportion	To estimate a population proportion, these requirements must be met: 1. A simple random sample must be taken. 2. There are at least 5 successes & at least 5 failures. 3. Those 4 conditions for the binomial distribution are satisfied (see above).	A simple random sample of 80 SRJC students found 51 were taking more than 8 units. Does this sample meet the requirements for estimating a population proportion?

(continued)

7.2 – Estimating a Population Proportion (continued)

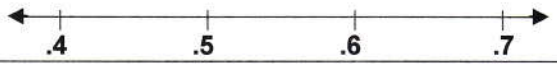
Concept	Details	Examples
Point estimate of a population proportion	A **point estimate of a population proportion** is a *single* value (or a point on a number line) that is used to approximate the population proportion. A sample proportion $\hat{p}$ is the best point estimate of the population proportion p. **(BTDT)**: An **interval** is all the numbers between two numbers on the number line. For example, this is the interval (–2, 5):  	Use the above sample of **80** SRJC students to find the point estimate of the population proportion of SRJC students taking more than 8 units. How confident are you that the true population proportion is *exactly* 0.64? If a sample of **10** SRJC students gave a point estimate of students taking more than 8 units to be 0.60, how confident would you be that the true population proportion is *exactly* 0.60?
Confidence interval (or interval estimate)	A **confidence interval** is a *range* (or an interval on a number line) of values used to approximate a population parameter (such as the population proportion). This range of values can be shown on a number line.	Instead of calculating a *point estimate* of .64, we can provide a *confidence interval* or *interval estimate* of, say, .54 to .74 (this is the interval from .64 – .10 to .64 + .10). How confident are you that the true population proportion is between .54 and .74 (this is the interval from .64 – .10 to .64 + .10)? How confident are you that the true population proportion is between .44 and .84 (this is the interval from .64 – .20 to .64 + .20)? Draw these two confidence intervals below.
Confidence level	Assume that the estimation process is repeated a large number of times. The **confidence level** is the proportion of times that the confidence interval actually does contain the population parameter.	
Interpreting a confidence interval	In Fig. 7-1, page 341, an estimation process was followed 20 times to estimate the "unknown" true population proportion . Each time a confidence interval with confidence level 95% was calculated. Because they are ***95%*** confidence intervals, we expect a 95% success rate; that is, 95% of the confidence intervals will actually contain the true population proportion.	Keeping in mind that the true population proportion is unknown, would it be correct to say "There is a 95% chance that the true population proportion falls in the first confidence interval shown in Figure 7-1"? You can read more about this on pages 340-341.
Confidence level notation	The confidence level proportion (or probability) is often expressed as $1 - \alpha$. That is, C.L. $= 1 - \alpha$	Find α for these common confidence levels • 90% $\alpha =$ • 95% $\alpha =$ • 99% $\alpha =$
Let's go over the Supplemental Sheet for Assignment #17.		



A **wider** confidence interval results in a confidence level.

7.2 – Estimating a Population Proportion (continued)

Concept	Details	Examples
z score **(BTDT)** (Sec. 3.4)	A **z score** is the number of standard deviations that a given value is above or below the mean. Use this formula: $z = \frac{x - \mu}{\sigma}$	One night Glenn's tips had a mean of \$7.79 and a standard deviation of \$2.44. Convert a \$7.20 tip to a z score. **$z = (7.20 - 7.79)/2.44 = -.241$**
Critical value **(BTDT)** (Sec. 6.2)	A **critical value** is a z score; it's the number on the borderline separating sample statistics that are "likely" to occur from those that are "unlikely" to occur. What "likely" means is determined by our confidence level. Critical values will also be used in Chapter 8.	Critical values for various confidence levels are:

Confidence level	α	$\alpha/2$	Critical value, $z_{\alpha/2}$
90%	0.10	0.05	1.645
95%	0.05	0.025	1.96
99%	0.01	0.005	2.575

Critical value notation	The critical value $z_{\alpha/2}$ is the positive z score that is at the boundary separating an area of $\alpha/2$ in the right tail of the standard normal distribution. Thus, the "likely" occurrences fall between $-z_{\alpha/2}$ and $z_{\alpha/2}$. See Figures 7-2 (page 342) and 7-3 (page 343).	The above table is also on page 343. Figure 7-3 (page 343) shows how $z_{\alpha/2}$ is found for a 95% confidence interval. Can the above table of critical values be included on a "cheat sheet"?
Error	The **error** is the difference between the sample proportion $\hat{p}$ and the population proportion p.	Of the population of 32,563 SRJC students, 6,219 are taller than 70 inches. The population proportion is 6,719/32,563 = **0.19**. Of the 43 students sampled in our Math 15 class survey, 7 are taller than 70 inches. The sample proportion is 7/43 = **0.16**. What is the error?
Margin of error (for a population proportion)	The **margin of error** is the maximum "likely" (with probability $1 - \alpha$) difference between the observed sample proportion $\hat{p}$ and the true value of the population proportion p. The margin of error is denoted by E and is found with this formula: $E = z_{\alpha/2}\sqrt{\frac{\hat{p}\hat{q}}{n}}$ (Formula 7-1, page 344)	A random sample of 80 SRJC students found 51 were taking more than 8 units. Find the margin of error that corresponds to a confidence level of 95%. We'll use $\hat{p}$ = $\hat{q}$ = n = . E =
Confidence interval for the population proportion p	The confidence interval for the population proportion p can be expressed in any of these ways: • $\hat{p} - E < p < \hat{p} + E$ • $\hat{p} \pm E$ • $(\hat{p} - E, \hat{p} + E)$ where E is . The confidence intervals we saw on the supplemental sheet for Assignment #17 (at `http://www.math.usu.edu/~schneit/Statlets/CI/index.html`) were created using this method.	When constructing a 95% confidence interval for the example above: 1. What is $\hat{p}$? 2. What is E? 3. What is $\hat{p} - E$? 4. What is $\hat{p} + E$? 5. Construct the confidence interval. ***or*** ***or*** .
Find $\hat{p}$ and E from a confidence interval	$\hat{p} = \frac{\text{upper} + \text{lower}}{2}$ $E = \frac{\text{upper} - \text{lower}}{2}$	Find $\hat{p}$ and E for this confidence interval: (.42, .68) $\hat{p}$ = E =